



## Satellite Eye for Galathea 3. Annual report 2006

**Hasager, Charlotte Bay; Sørensen, Peter; Pedersen, Leif Toudal; Høyer, Jacob L.; Jørgensen, P.V.; Højerslev, N.K.; Rasmussen, M.S.; Andersen, O.B.; Christiansen, Merete Bruun**

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## Satellite Eye for Galathea 3 Annual Report 2006

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Risø-R-1594(EN)



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**Title:** Satellite Eye for Galathea 3 Annual Report 2006  
**Department:** Wind Energy Department

**Abstract (max. 2000 char.):**

The Satellite Eye for Galathea 3 project is collecting satellite images from many satellites and, in particular, from the European ENVISAT satellite along the Galathea 3 global route. The expedition takes place from 11 August 2006 to 27 April 2007. Prior to the expedition several satellite images were collected from locations along the planned route. During the expedition large amounts of satellite images are collected and stored in a database. Most images can be viewed online through Google Earth along with the ship observations in near-real-time. This means that researchers onboard the ship Vædderen, pupils in the classrooms and the public at any moment can take a look at the conditions seen from the eyes of the Earth observing satellites.

Environmental monitoring from satellite is among the most important and outstanding technical developments since the last Galathea expedition in the years 1950-52. At the same time the internet has made it possible to publish the satellite images in near-real-time. Furthermore, all Danish schools and most Danish pupils have good access to computers and web connection, such that they can make use of the information in daily school life. The ESA Eduspace education is supporting Satellite Eye with the expertise and a large quantum of satellite images from Envisat ASAR and MERIS, PROBA and SPOT.

The access to satellite images form the background for the development of internet-based educational material in satellite remote sensing. The satellite images reveal conditions and dynamical processes in the oceans, the atmosphere, the land surface soils and vegetation, urban development as well as snow and ice. A series of 9 running projects (Sea surface temperature, Algae concentration, Radar images of the surface, Atmospheric pollution, Ocean wind, Weather, Ocean sea level, Harbours en route and Earthquakes and gravity) for education are prepared in Danish and English during the first year. Furthermore, 24 case studies along the Galathea route are planned, several of them in cooperation with researchers in the various Galathea 3 projects with whom we cooperate. A few case studies have been finished in year 2006 (Ocean features and oil spill, Sea and ice, Wind power in Cape Verde, Cities seen from radar). The educational material is available at the EMU. At [www.satelliteeye.dk](http://www.satelliteeye.dk) there are links to the educational material. Furthermore, the image of the week is published here.

Satellite Eye has contributed with satellite sea ice maps near Antarctica to the Navy for a safe route planning.

Satellite Eye for Galathea 3 is funded by the Egmont Fonden and the participating institutes.

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## Preface

Galathea 3 is the third of the global ship expeditions headed by Denmark. Galathea 3 takes place from 11 August 2006 to 27 April 2007.

Environmental monitoring from satellite is among the most important and outstanding technical developments since the second Galathea expedition in the years 1950-52.

The Satellite Eye for Galathea 3 project is responsible for ordering and archiving relevant satellite images along the entire track. Special efforts are made to collect images from Envisat, the largest environmental satellite in space operated by the European Space Agency. Furthermore, easy access to the processed images in near-real-time for the public is made through Google Earth.

Danish schools take part in Galathea 3 both on-board and in the classrooms. In Satellite Eye educational material is produced. The material is published at EMU, the portal for education in Denmark. The database of satellite images is combined with in-situ observations from the ship, and this provide added value to the educational material.

Satellite Eye cooperates with researchers in 18 of the Galathea 3 projects. This is to plan image ordering and download relevant images for the research, and to help and guide some of the projects on satellite images. Scientific research is also done within the Satellite Eye project.

## Acknowledgements

The Satellite Eye for Galathea 3 project is realized through the financial support of Egmont Fonden of DKK 3.9 million and the financial support of the participating institutes Risø National Laboratory at DTU, the Niels Bohr Institute and GRAS A/S c/o Institute of Geography both at University of Copenhagen, Danish Meteorological Institute, ESA EDUSPACE and the National Danish Space Centre at DTU. In addition a large amount of Envisat satellite scenes are kindly granted from ESA through EDUSPACE. The financial support and satellite scenes are greatly acknowledged.

Funding alone does not make a project successful. It is the support and cooperation between people that makes the work exciting, worthwhile and valuable. Therefore the Satellite Eye project wishes to thank the following:

Grethe Nymark, our project manager at Egmont Fonden, and Margrethe Ahlefeldt, director of Egmont Fonden, for their continued support including participation in several meetings, inspiring dialogue, and help on design of our logo by Morten Sørensen at Kontrapunkt.

At Dansk Ekspeditionsfond we acknowledge the support of Jens Claus Hansen, manager of office and commander senior grade of the Royal Danish Navy, Morten Meldgaard, director, Lisbeth Nannestad Jørgensen, communication officer, Søren Haslund-Christensen, chair of the board and Thomas Birk, employee.

In the Royal Danish Navy we wish to acknowledge Lars Hansen, commander senior, Dennis Vad, lieutenant commander, and Kenneth Flagmand Olsen, lieutenant commander, for the timely information on geographic coordinates along the Galathea 3 expedition. This information has been extremely valuable for our ordering of satellite images along the entire expedition.

We wish to thank in particular Martin Bech and Michael Viskum and Anders Raun, at Uni-C and EMU, the portal of the Ministry of Education, for hosting the educational material from Satellite Eye. This enables a clear visibility to our core customers: the pupils, students and teachers in Denmark. Also the positive engagement from Jørgen Balling Rasmussen, assistant secretary in the Ministry of Education, has been very valuable for our project.

At DIFRES at DTU we wish to thank Brian James Cowan for the set up of ship data transfer to Satellite Eye. We use the ship data in Google Earth for public viewing and education.

At the early start of Satellite Eye for Galathea 3 it was obvious to us that the satellite images would be useful in several Galathea 3 projects. At the time of proposal writing we were in contact with colleagues from four projects, Kathrine Richardson and Lise Lotte Sørensen in the Carbon Cycle project, Rene Forsberg and Ole Balthazar Andersen in the Gravity project, Kjeld Rasmussen in the CLIP (Bellona Island) project and Niels Christian Nielsen and Janne Liburd in the St. Croix in past and present project. The supporting letters from these projects for Satellite Eye are greatly appreciated. Furthermore we enjoy the continued cooperation.

As soon as Satellite Eye became a reality and it became known among the Galathea researchers, we got in contact to many more Galathea 3 projects. At the time of writing Satellite Eye is supporting 18 Galathea 3 projects with satellite images. We appreciate

the cooperation with all the projects. A listing of all the projects and people involved is found in chapter 6.

Galathea 3 is visited by many pupils and teachers. Satellite Eye is in particular glad to support the Galathea classes and their teachers and support the teaching activities in these exciting projects. The Galathea classes include the students and teachers from

- Erhvervsskolen Hamlet 2b HTX;
- Borupgaard Amtsgymnasium 2x;
- Bagsværd Kostskole og Gymnasium 2b.

All three classes are among the five winning classes in the competition organized jointly by Politiken, STV/TV2 Vejret and Eksperimentarium.

Several satellite images have been ordered through GRAS and we wish to thank Mikael Kamp Sørensen for the great collaboration.

EduGIS is the group of experienced teachers from gymnasium that are taking great effort in preparing the educational material in a form useful for teachers and pupils. Their continued engagement is absolutely necessary to for the Satellite Eye group. We wish to thank Karl-Erik Christensen and Torben P. Jensen.

Last, but not least, we would like to thank colleagues within our institutes for their help. At Risø thank goes to our web-master René Møller, Lise Lotte Sørensen, Jesper Nissen, Poul Astrup, Niels Gylling Mortensen, Jens Carsten Hansen and Per Nørgaard. Also Lars Landberg, head of program, and Erik Lundtang Petersen, head of department, are acknowledged for their continued support to the Satellite Eye for Galathea 3 project.

# 1 Introduction

## 1.1 Background

The Danish Expedition Foundation was established to ensure the Galathea 3 expedition. The background for the Galathea 3 expedition was based on the understanding that our society greatly rely on science and education in the future.

There is a declining tendency of young people aiming for professional careers in physical and technological sciences. It is important to stimulate further interest among the young people in these subjects. It is the hope that Galathea 3 and the science onboard will stimulate especially young people. The educational aspect of bringing the science to the classrooms is very important for Galathea 3. Source: <http://www.galathea3.dk/uk/Menu/The+expedition/Background>

## 1.2 Goal

The goal of the ‘Satellite Eye for Galathea 3’ project is to provide a living atlas based on satellite images along the track of Galathea 3. It is a technological challenge to access, archive and distribute the satellite Earth Observation images in near real time for science and education. Vast amounts of satellite data are handled and state-of-the-art technologies are further developed and used for scientific and educational aspects.

To ensure an optimal coverage of satellite Earth Observation data along the track of Galathea 3, it has been imperative to systematically pre-order satellite images from the European Space Agency (ESA) satellite Envisat. Other high, medium and low-resolution satellite images from many other satellite sensors have been accessed in addition.

Galathea 3 is a moving ground truth laboratory for a number of physical and chemical parameters observed in situ at the ship and from space from the satellites collocated in time and space. The satellite images provide visual evidence of highly dynamic phenomena in the marine, atmospheric and coastal environments. To gain full scientific and societal benefits of the Galathea 3 cruise, it is vital to compare and relate both types of data.

## 1.3 Objective

The objective of Satellite Eye for Galathea 3 is to enable a systematic pre-ordering, recording, archiving, data handling and distribution of satellite Earth Observation images for science and education along the track of Galathea 3.

Summary of major results in Satellite Eye for Galathea 3 in year 2006

- Establishment of web-site [www.satelliteeye.dk](http://www.satelliteeye.dk) that contains a description of the project, short cv's of the participants in the project, the weekly images, links to the 18 Galathea 3 projects and 3 Galathea 3 school classes that we support with satellite images, an updated list and links to news on Satellite Eye. All



web-pages are available in Danish and English. Furthermore, there are links to the DRC-DTU web site, the EMU web-site and the ESA Eduspace web-site.

- Establishment of web-site <http://galathea.oersted.dtu.dk> that contains the Google Earth display of the satellite images, the ship position and selected observations from the ship, the planned route and description for the satellite images. Late in year 2006 the new version of Google Earth supports animations and this is used to show sea surface temperature and sea ice changes through time. Google Earth is easy to use and it is broadly used by pupils, teachers, people at Galathea and the public. Furthermore the web-site hosts the JAVA database and the image database. These are ways to access the stored satellite images for skilled users.
- Establishment of web-site <http://galathea3.emu.dk/satelliteeye> hosted at Uni-C for EMU Danmarks Undervisningsportal. At this site the educational material in the 9 running projects (with circum-global content) are published and 24 case studies (with site specific content) will be published. All running projects are published in year 2006 both in Danish and English. For the case studies only 6 are published. The rest is in preparation, several of them in cooperation with the Galathea projects onboard.
- Publication of results through media, see list at <http://www.satelliteeye.dk/news.htm>
- Scientific cooperation on satellite images with 18 Galathea projects
- Educational cooperation on satellite images with 3 Galathea school classes

## 1.4 Examples of the three home web-pages

[www.satelliteeye.dk](http://www.satelliteeye.dk)




# Satellite Eye for Galathea 3




MENU

- Homepage
- Background
- Galathea 3 databank
- Education
- Running projects
- Case studies
- Cooperation
- Who are we?
- News

GOOGLE EARTH

Follow Galathea 3 on Google Earth



WEEKLY IMAGE

Icebergs near Antarctica



Previous weekly images

LINKS

- Satellite Eye on Ørsted-DTU
- EDUSPACE
- ENVISAT
- EMU
- Risø Wind Maps

COOPERATION

- Carbon Cycle
- Gravity
- St. Croix
- Mercury
- WINMARGIN
- Greenland Climate
- Bellona Climate
- Solomon Birds
- Sea Turtles
- Oxygen in Oceans
- Dissolved Organic Matter
- Sound in the Oceans
- Plankton Dynamics
- Eels Breeding
- Cool-water carbonate
- Icefish of Antarctica
- Dinoflagellates
- Oxygen from algae
- Footprint of Darwin
- Galapagos plants
- Tranquebar



## Welcome to Satellite Eye for Galathea 3

Satellite Eye for Galathea 3 combines observations from the expedition to satellite image information for use in education. Through this we will demonstrate that physical sciences and the work with physical sciences subjects are exciting and attentive.

The produced educational material is given free of charge for the schools through EMU - Danmarks undervisningsportal.

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[http://galathea.oersted.dtu.dk/index\\_e.html](http://galathea.oersted.dtu.dk/index_e.html)




# Satellite Eye for Galathea 3 at Ørsted-DTU



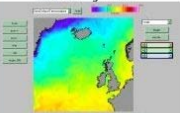

GOOGLE EARTH

Follow Galathea-3 in Google Earth



JAVA Interface

See using JAVA



IMAGES DATA BASE

See satellite images over the research areas



WELCOME

## Welcome

### Web-site for Ørsted-DTU's participation in Satellite Eye for the Galathea-3 expedition.

We use various technological platforms for distribution of satellite data covering the Galathea Expedition. The purpose is to provide live daily coverage of the ship route and selected locations along the track.

News: SST from 4 different metode



Image of the week

G3 DATA BASE



Data from Galathea 3

LINKS

- Satellite Eye
- SST at DMI
- Algal at DMI
- IPY at DTU
- PolarView at DTU
- Ice/weather/ocean at DTU
- News from Esa
- 
- DTU's polar watch
- DTU and the international polar year (IPY)
- EDUSPACE
- ENVISAT
- EMU

The Satellite Eye project is coordinated by Risø National Laboratory and sponsored by

Risø-R-1594(EN)

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<b>EMU   Danmarks undervisningsportal</b>		<a href="#">EMU forsider</a> • <a href="#">Designværktøjet</a> • <a href="#">EMU-Taller</a> • <a href="#">ENG</a> • <a href="#">Fagernes Infoguide</a> • <a href="#">Galathea 3</a> • <a href="#">Gymnasiet</a> • <a href="#">Kontakt</a> • <a href="#">KPI</a> • <a href="#">Mediaplatformen</a> • <a href="#">Naturvidenskab</a> • <a href="#">Person.emu.dk</a> • <a href="#">SciDa</a> • <a href="#">Slide-IT</a> • <a href="#">Skolekon</a> • <a href="#">Skolekassen</a> • <a href="#">Support</a> • <a href="#">Tilgængelighed</a> • <a href="#">Uddannelsesforum</a> • <a href="#">Udviklingsplaner</a> • <a href="#">Udviklingsprojekter (FulD)</a> • <a href="#">Vejsviser</a>		<a href="#">UNI-Login</a>	
<b>Galathea 3</b>					
<ul style="list-style-type: none"> <li>Galathea 3</li> <li>MiniGalathea</li> <li>Biologi</li> <li>Geologi</li> <li>Klima og miljø</li> <li>Kultur og historie</li> <li><b>Satellite Eye</b> <ul style="list-style-type: none"> <li>Projekter</li> <li>Undervisningsforløb</li> <li>Ugens satellitbillede</li> <li>Satellite Eye (in English)</li> </ul> </li> <li>Galathea News</li> <li>Farvandsvæsenet</li> <li>Her er Galathea 3</li> <li>Galathea 3 kalenderen</li> <li>Galathea 3 bloggen</li> <li>Klassen arbejder</li> <li>Galathea 3 en español</li> <li>Galathea 3 in English</li> <li>Videoarkiv</li> <li>På tværs</li> <li>Undervisningsforløb</li> <li>Midtvejsevaluering</li> <li>Nyhedsbrev</li> </ul>	<h3>Satellite Eye for Galathea 3</h3> <p>Satellite Eye for Galathea 3 sætter ekspeditionens arbejde i sammenhæng med satellitbaserede observationer til brug i undervisning for derigennem at vise, at naturvidenskab og det at arbejde med naturvidenskabelige emner er både nærværende og spændende.</p> <p>Satellite Eye vil på hele turen udnytte satellitbillederne og målingerne i en række undervisningstemaer - <b>løbende projekter</b> - der tilbyder aktiviteter langs ekspeditionens rute samt i færdige <b>undervisningsforløb</b> - der behandler særligt interessante temaer forskellige steder langs ruten.</p> <p>Projektet har følgende partnere:</p> <ul style="list-style-type: none"> <li>• Risø National Laboratory, projektledeelse</li> <li>• Ørsted Institutet, Danmarks Tekniske Universitet</li> <li>• Danmarks Meteorologiske Institut</li> <li>• Niels Bohr Institutet, Københavns Universitet</li> <li>• ESA/EDUSPACE</li> <li>• Geografisk Institut, Københavns Universitet</li> </ul> <p>Satellite Eye for Galathea 3 er finansieret af Egmont Fonden.</p> <div> </div> <div> <b>Links</b> <ul style="list-style-type: none"> <li><a href="#">Satellite Eye for Galathea 3</a></li> <li><a href="#">Satellite Eye på Ørsted-DTU</a></li> <li><a href="#">EDUSPACE</a></li> <li><a href="#">ENVISAT satellitten</a></li> </ul> </div>				
<p>Revision: 02/02 2007 <a href="http://www.emu.dk">www.emu.dk</a> © 2007.</p> <p style="text-align: right;"><b>UNI•C</b></p>					

## 2 Partners

The Satellite Eye for Galathea 3 project has the following partners

- Risø National Laboratory - DTU, project management
- Danish National Space Center – DTU
- Danish Meteorological Institute
- Niels Bohr Institute, University of Copenhagen
- ESA/EDUSPACE
- GRAS A/S c/o Institute of Geography, University of Copenhagen

Charlotte Bay Hasager and Merete Bruun Christiansen, Risø-DTU

Leif Toudal Pedersen and Ole Baltazar Andersen, DRC-DTU

Jacob L. Høyer and Peter Viskum Jørgensen, DMI

Niels Kristian Højerslev, NBI-KU

Jürg Lichtenegger and Peter Brøgger Sørensen, ESA Eduspace

Michael Schultz Rasmussen, GRAS and GI-KU

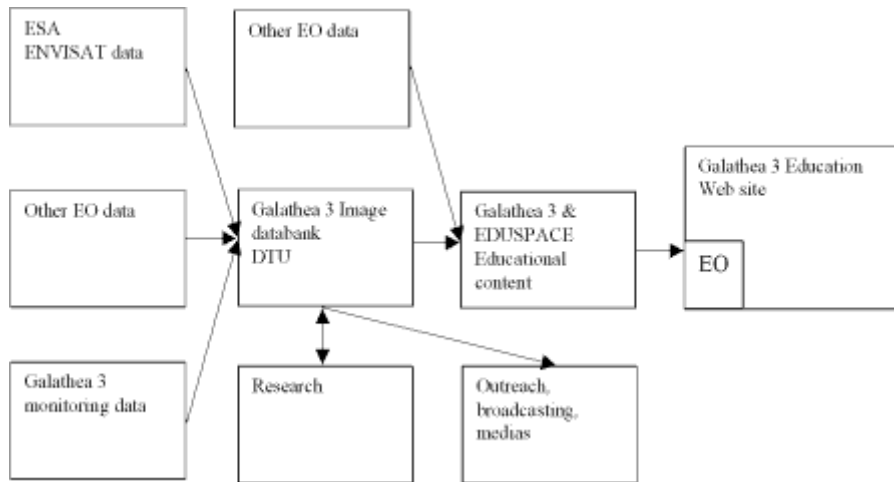
For details on the people involved please visit the ‘Who are we?’ at

[http://www.satelliteeye.dk/whoarewe\\_uk.htm](http://www.satelliteeye.dk/whoarewe_uk.htm)

At this site a brief cv and the major contribution in the project are published.

### 3 Project structure

Satellite images and observations from the ship are stored in a database useful for education and research.



*Diagram of the Galathea 3 image databank in relation to education and other publication.*

By coupling observations for the expedition with satellite images, the pupils are presented with state of the art technologies. This is not just a long list of numbers in a table form but comprehensive maps with images visually presented in an up-to-date fashion.

Please visit [http://galathea.oersted.dtu.dk/index\\_e.html](http://galathea.oersted.dtu.dk/index_e.html) to see the live system.

## 4 Project education

By using state of the art environmental monitoring from the environmental monitoring satellite Envisat from the European Space Agency (ESA), it is possible to combine the observations from Galathea 3 both at local, regional and global level.

EDUSPACE is ESA's homepage for Earth Observation for upper secondary schools education. Within EDUSPACE image processing software, LEOWorks, has been developed. This enables pupils to visualize and analyse satellite images. Furthermore, within EDUSPACE a series of full educational cases for several disciplines with use of satellite images have been produced. EDUSPACE is available in English, German, French, Italian, Spanish and Danish, while translations to Portuguese and Dutch are in preparation.

Through EDUSPACE permission from ESA has been granted to free of cost to use several types of satellite images for the complete Galathea 3 expedition cruise for use in education. The images are delivered in near-real-time, on a best-effort basis. The images are available from [http://galathea.oersted.dtu.dk/index\\_e.html](http://galathea.oersted.dtu.dk/index_e.html)

The satellites observe the conditions and dynamical processes on our globe. In order for the pupils and teachers in the classroom to benefit from the satellite images collected along the track of Galathea 3, a series of circum-global educational projects have been developed by the Satellite Eye partners.

### 4.1 At EMU

There are 9 running projects and they are all published. They are hosted at

<http://galathea3.emu.dk/satelliteeye/projekter/index.html>

There is also a series of 24 educational case projects in development. Several of those have been published, the others are in progress. The case projects are hosted at

<http://galathea3.emu.dk/satelliteeye/casestudies/index.html>

It should be noted that several case studies include information from the research projects onboard.

All educational material is available at [EMU](#).

[http://galathea3.emu.dk/satelliteeye/index\\_uk.html](http://galathea3.emu.dk/satelliteeye/index_uk.html)

### 4.2 Cooperation with Galathea classes

Several classes have participated in the educational science competition organized by by Politiken, STV/TV2 Vejret and [Eksperimentarium](#). Three of the winning classes are supported by Satellite Eye with classroom education and satellite images. The classes are:

erhvervsskolen Hamlet, 2B HTX on the project ['The largest of the smallest. From Kattegat Sea to Galapagos'](#). The project deals with mapping of DNA in dinoflagellater collected in the Kattegat Sea and Galapagos. The students and teachers have visited Risø and learnt about satellite images and the program LEOworks from the 29.11. to 1.12.2006.

Borupgaard Amtsgymnasium, 2X on the project ['The oxygen production from algae in the oceans'](#). The project deals with the oxygen production of algae, CO<sub>2</sub> and pH values in oceans through 50 years from Galathea 2 to Galathea 3. The study site is from Tórshavn to Nuuk. The students and teachers have visited Risø and learnt about satellite images on the 13.10.2006.

Bagsværd Kostskole og Gymnasium, 2B in the project ['Determination of plants in the footprint of Darwin'](#). The project is about plants in Galapagos. A land-based field study will take place in Galapagos in February and March 2007. For use in the field work high-resolution satellite images are used. Satellite Eye has educated the class on satellite images on the 26 January 2007. In addition the class will work closely in the field in Galapagos Islands with Satellite Eye.



## 5 Project science

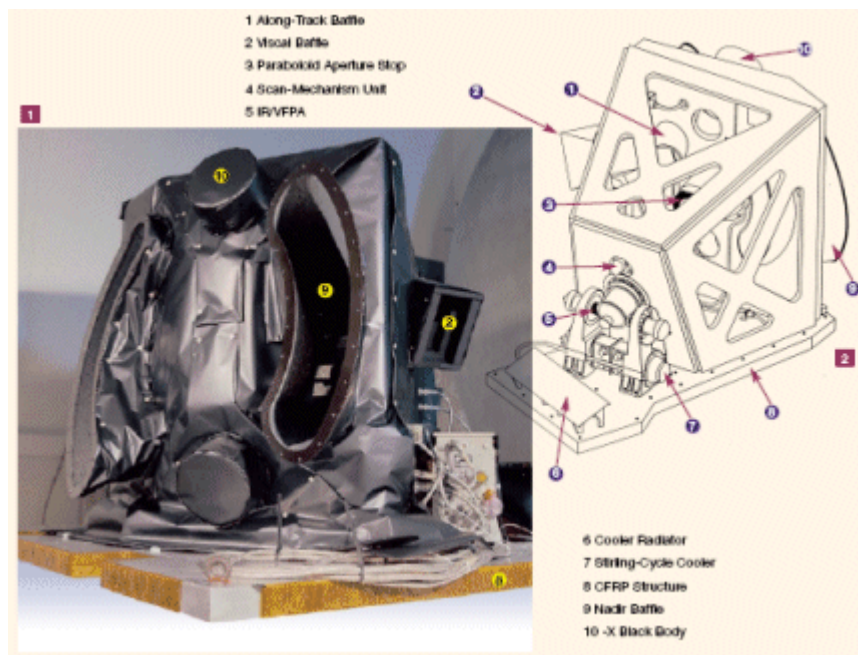
### 5.1 Calibration track

Satellite Eye for Galathea 3 contains the science part of using the ship Vædderen as a global calibration track. Some of the parameters observed by the satellite are also observed onboard the ship. Thereby a global calibration experiment is undertaken by Satellite Eye.

The infrared radiometer was installed prior to the cruise. Sea surface temperatures are hence observed by four different methods:

- the satellite sea surface temperature (SST)
- the ferry box inlet water temperature;
- the ship hull temperature;
- the infrared ship-mounted radiometer sea surface temperature (SST)

### 5.2 Satellit observations of SST



*Figure of satellite radiometer.*

At the time of writing, several satellites are in orbit carrying instruments that observe SST. Most of these observations are being collected by the Satellite Eye project and are combined to daily high-resolution images of satellite sea surface temperature (SST). The spatial resolution and the temporal resolution from the satellite observations vary among instruments.



In the table below, an overview of the major sources of satellite SST is given. Please note that observations from TMI and SEVIRI only can be used for the regions between latitude 40 degrees south and 40 degrees north.

Instrument	Satellite	Spatial resolution	Temporal resolution	Observing techniques	Expected error, in std. dev. in °C
AATSR	ENVISAT	1 km	~1 time each 2-3 days	IR	0.3
AVHRR	NOAA polar orbit	2 km	Twice daily	IR	0.5
AMSR-E	Aqua	25 km	Daily	MB	0.7
TMI	TRMM	25 km	Twice daily	MB	0.7
MODIS	Aqua	2 km	Daily	IR	0.7
SEVIRI	Meteosat-8	5 km	Every hour	IR	0.8

*Table 1: Overview of the sources for high-resolution satellite SST observations is listed. IR is infrared and MB is microwave.*

The data are collected by use of the Sea and Sea-ice SAF (Satellite Application Facility) belonging to EUMETSAT (Satellite operator for the European Meteorological Institute).

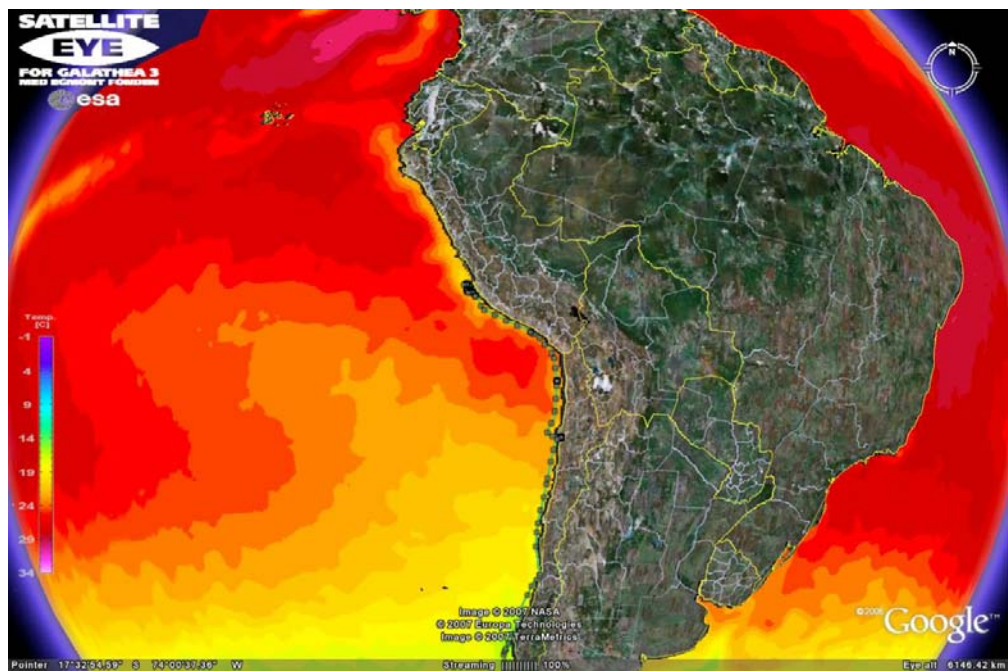
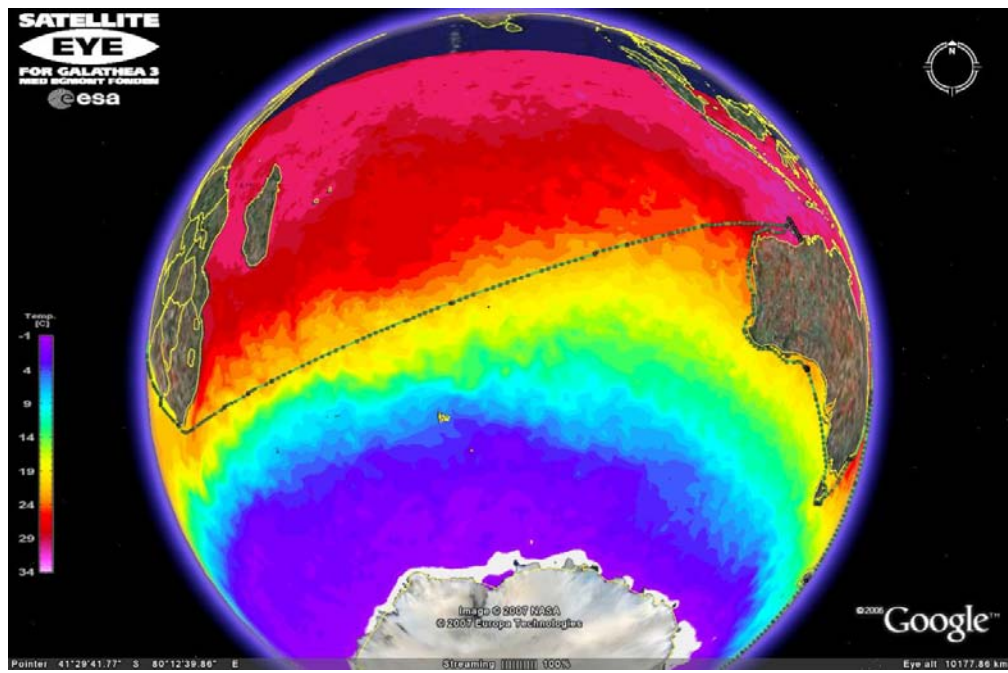
As the infrared observations are limited by cloud cover and the microwave observations are of rather low spatial resolution, an interpolation scheme for the data has been applied in order to obtain high-resolution SST maps without gaps.

Observations listed in the table therefore have been collected by DMI and a method called objective analysis has been applied. This method uses statistics to fill out gaps and provide and interpolated SST map each data with a spatial resolution at around 5 km.

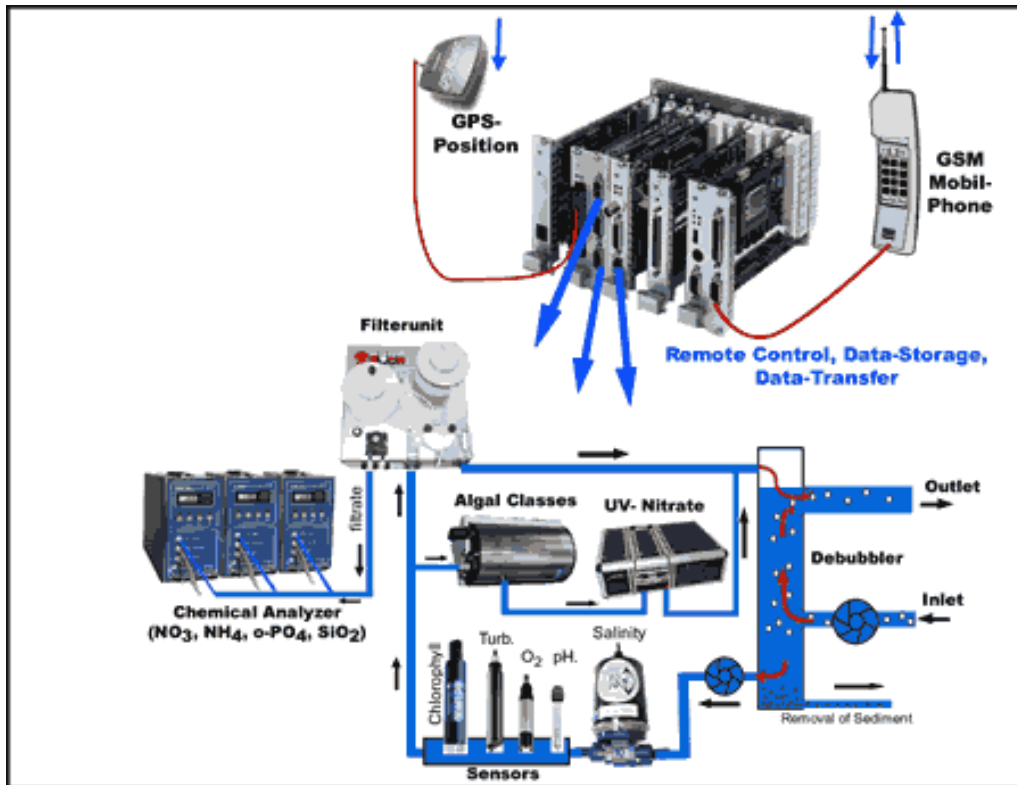
The infrared radiation and the microwave radiation originates from the upper millimeter or less of the sea surface, but the sea surface temperatures presented are corrected such that they represent the temperature of the upper one meter. This has been done by inter-comparing vast amounts of observations from ships with satellite observations.

Two maps of satellite SST are shown from 24 February 2007. The first map covers the Indian Ocean. It is clear that the ocean is warm near the Equator and cool near Antarctica. The other map covers the ocean along the west coast of South America. It can be noted that the ocean is rather cool along the coastline compared to further offshore. The cool water stems from upwelling of cold water from the bottom to the surface layer. The Galathea 3 expedition is doing investigations in the cool water masses. The upwelling is associated with input of nutrients from the bottom to the ocean surface layer that feed phytoplankton and the rest of the marine food web (fishes etc.).

Animations of satellite SST can be viewed in Google Earth from [http://galathea.oersted.dtu.dk/GE\\_animation.html](http://galathea.oersted.dtu.dk/GE_animation.html) and regionally at <http://galathea.oersted.dtu.dk/SST.html>



### 5.3 Ferrybox sea temperature



The image comes from <http://www.ices.dk/>

The Ferrybox was developed to collect oceanographic data from merchant- and passenger ships. The Ferrybox is mounted near the ship's water intake and the observations are taken from the water passing through the instrument. The parameters observed are temperature, salinity, oxygen level and concentration of different algae (phytoplankton).

It is the Ferrybox temperature data that are viewed in Google Earth using [Rute med data](#)

Examples from four continents are given in order to show an overview of ferrybox temperatures observed at Vædderen during the expedition. Each 'balloon' is marked for every three hours (yet the 5 minute data are also accessible from ASCII and Excel spreadsheet through Google Earth).

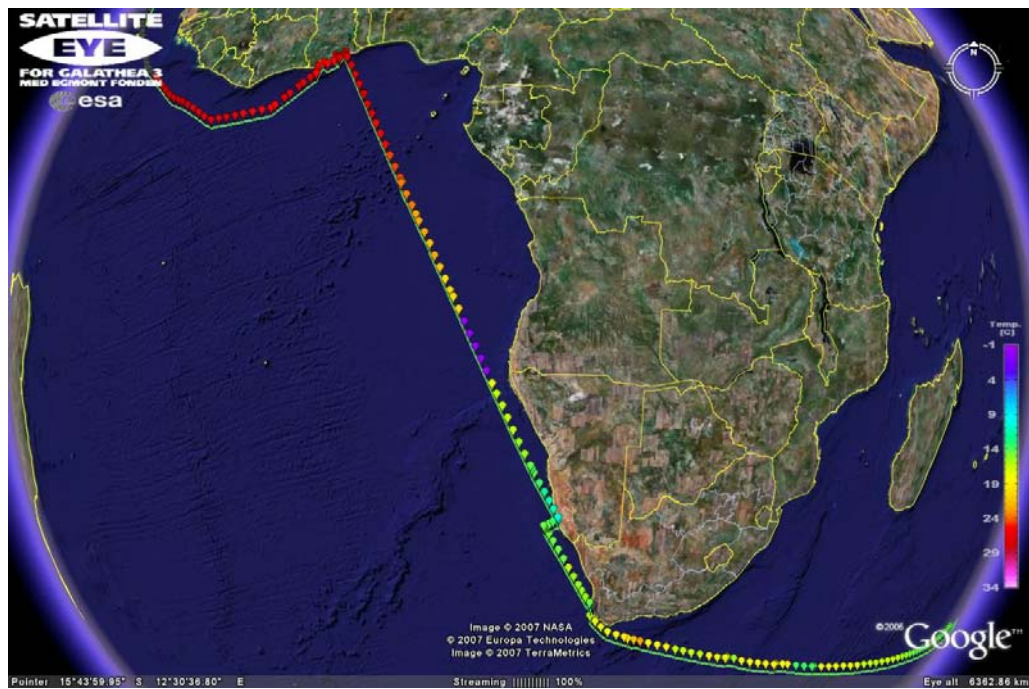
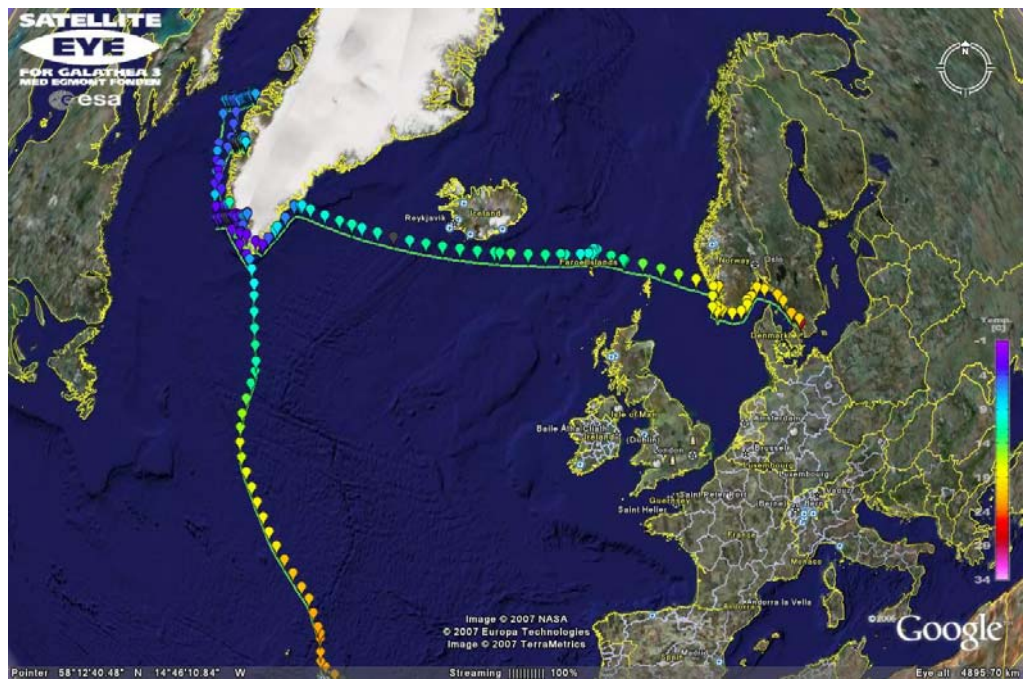
The first track is from the North Atlantic in Europe. It is clear that the ocean near Greenland is cooler than the Danish Seas and further south in the Atlantic Ocean.

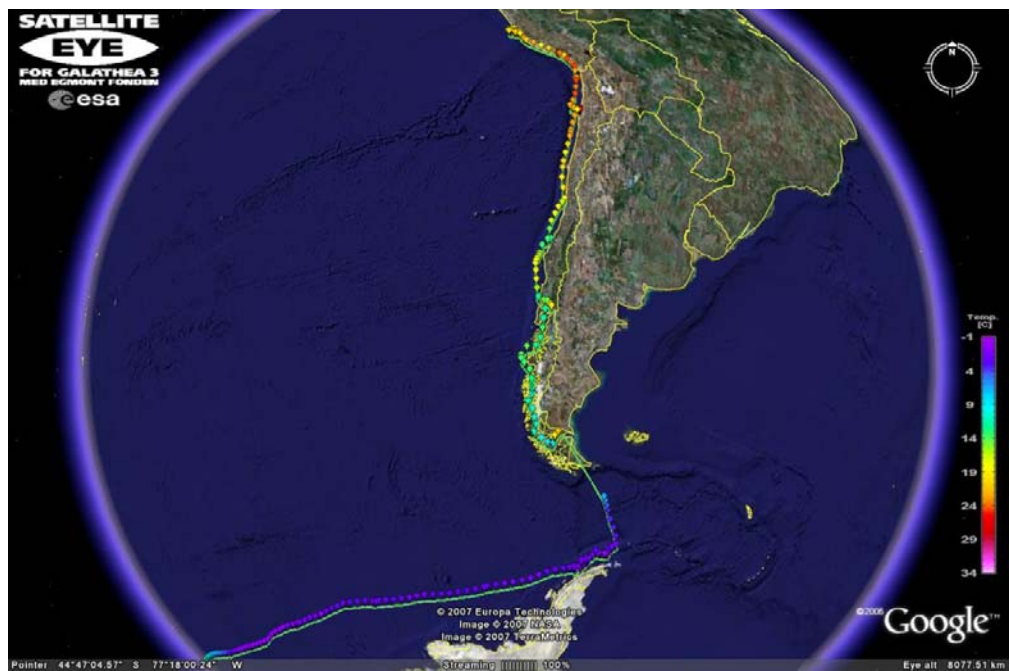
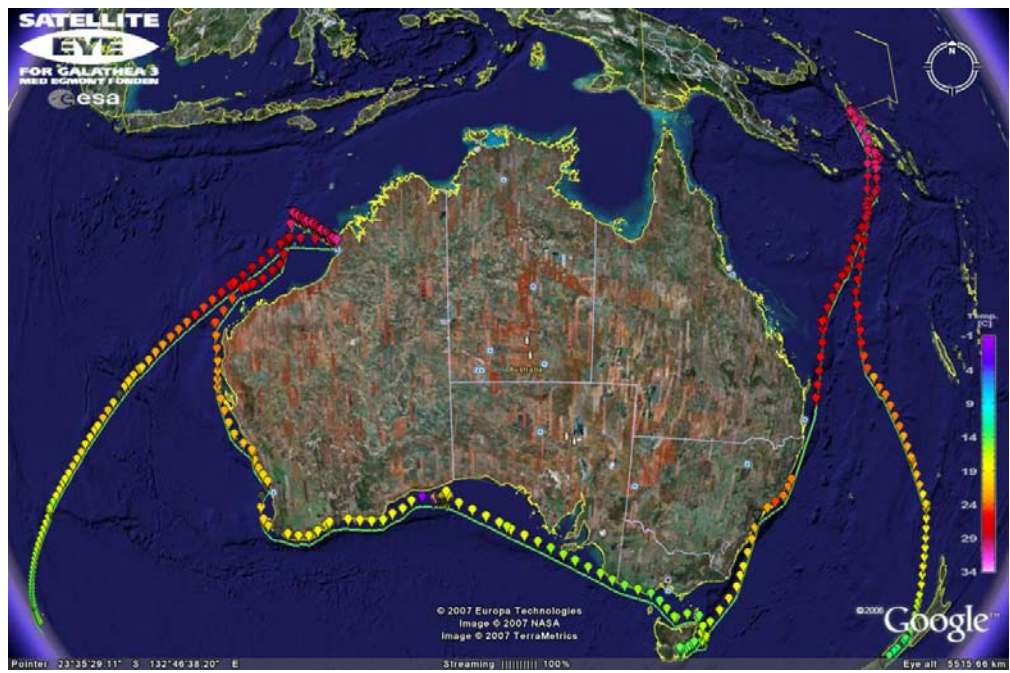
The second track is from the west coast of Africa. It is seen that the ocean is very warm near the Equator and the temperatures decrease south. However, outside the border between Angola and Namibia very cool water was observed during some hours (note the purple is cooler than the yellow). It is most likely an upwelling zone with much cooler water.

The third track is from Australia. The ocean north of Australia is much warmer in the south.

The fourth track goes from Antarctica and South America. Cool water is seen along Antarctica. The ocean along the west coast of South America is only moderately warm.









## 5.4 Ship hull temperature

The ship hull temperature is observed on the inside of the ship hull. The thermal conductivity of the ship hull is so large that this temperature is very close to the ferry box observed temperature with a water inlet at 4 meter depth.

## 5.5 Infrared SST



*Figure The Vaisala infrared thermometer onboard Galathea 3*

The Satellite Eye project operates an infrared radiometer (Vaisala) onboard Galathea 3. The instrument observes the thermal infrared radiation from the sea surface and this radiation is converted to a temperature. The radiation comes from the top of the ocean surface.

### Penetration depth

The infrared radiation penetrates less than millimeter into the ocean, and therefore the radiation observed by infrared instruments only represent the temperature at the top of the ocean surface. The temperature observed from the radiation temperature often is referred to as the skin temperature because it only represents the skin of the ocean surface. This means that the radiation temperature of the ocean is not equal to the bulk surface temperature but that it is slightly lower.

In daylight hours the temperature difference can reach 0.5 °C whereas at night it usually is around 0.2 °C or less lower. From a physical concept the radiation temperature and the bulk temperature have different characteristics. From a practical point of view, however, they have much in common.

This has lead to the development of various algorithms from which one can extract the sea surface bulk temperature from the radiation temperature.

Other comparisons are between the chlorophyll content observed onboard the ship and with ENVISAT MERIS images. Wind data are observed onboard the ship and are compared with ENVISAT ASAR images and QuikSCAT images of ocean wind maps. Weather data of clouds can be compared to forecasted meteorological conditions.

Several phenomena observed from space such as sea ice and sea ice near Antarctica; glaciers in Greenland; vegetation in Galapagos and Salomon Islands; coastal erosion in Tranquebar; internal waves in the Indian Ocean; and many other topics are addressed. The science part is ongoing.

## 6 Cooperation

At the writing of the project proposal we knew 4 of the Galathea 3 science projects would like to cooperate with Satellite Eye. It has turned out by the time of writing (8 February 2007) that 18 of the Galathea 3 science projects are in cooperation with Satellite Eye. For a list of those, see [http://www.satelliteeye.dk/cooperation\\_uk.htm](http://www.satelliteeye.dk/cooperation_uk.htm)

Brief information on the cooperation in each project is listed below and the contact persons in the table.

### 6.1 List of projects

#### Carbon Cycle

Satellite Eye collects for the [Carbon Cycle Project](#) satellite sea surface temperature, ocean color and wind maps for the project for the analysis of the ocean carbon budget. Ocean wind, sea surface temperature and air temperature from the ship collected by [Risø](#) and [DMI](#) can be viewed with the satellite images in near-real-time.

#### Gravity

Satellite Eye collects for the [Gravity Observation Project](#) images of sea surface temperature and ocean colour that can help guide the scientists to collect their observations at the existing interesting fronts in the ocean viewed from satellite in near-real-time. The gravity fields are observed from radar altimetry satellite images providing maps of the sea surface height. Observations of sea surface height observed on-board Galathea by the [Danish Space Centre](#) will be shown on-line in the satellite images.

#### St. Croix

Satellite Eye collects for the [St. Croix Project](#) optical and synthetic aperture radar (SAR) images of the St. Croix Island to help identify changes in land use during time in last few decades.

#### Mercury

Satellite Eye collects for the Mercury in the [Atmosphere Project](#) images of atmospheric chemistry concentrations in the atmosphere. These data can be viewed together with atmospheric chemistry observations from the ship in near-real-time collected by the [National Environmental Research Institute](#).

#### WINMARGIN

Satellite Eye collects for the [West Indies Marine Geosciences Investigations \(WINMARGIN\)](#) satellite images of the transport of river sediments from the Americas and long-range atmospheric transport from the Saharan desert in Africa to the West Indies for the understanding of the investigated sedimentation cores records collected by [GEUS](#).

#### Greenland Climate

Satellite Eye collects for the [Greenland Climate Project](#) satellite images of the glaciers through time. This is to support the study of climate change in the Greenland area.



## **Bellona Climate**

Satellite Eye collects for the [Bellona Climate Project](#) satellite images to characterize land use and changes in this during time. High-resolution optical images will be analyzed to give great detail in the processes due to climatic effects and the living conditions.

## **Solomon Birds**

Satellite Eye collects for the [Solomon Birds Project](#) satellite images to help identify adequate helicopter landing sites in the densely vegetated tropical forest. Helicopter is the access route for the search for passerine birds in very remote areas that carry specific DNA evolved through time under these isolated conditions.

## **Sea Turtles**

Satellite Eye collects for the [Sea Turtles Project](#) satellite images of sea surface temperature, ocean wind and ocean color that may help identify areas where the sea turtles are. When sea turtles have been collected and given a radio-transmitters, the traveling of the sea turtles and each individuals exact position can be viewed along with the near-real-time satellite. This will provide insight to their lives.

## **Oxygen in Oceans**

Satellite Eye collects for the [Oxygen in Oceans Project](#) satellite images of ocean color, chlorophyll content and sea surface temperature. The daily project planning on-board will be made from the most recent near-real-time satellite images in order to search and observe the oxygen content in the most interesting parts of the ocean.

## **Dissolved Organic Matter**

Satellite Eye collects for the [Dissolved Organic Matter Project](#) satellite images of chlorophyll and ocean color which may help identify areas with gradients in near-real-time. This may help identify interesting sampling locations. At the same time near-real-time observations from the ship collected by [DMU](#) may be viewed with the near-real-time satellite images along the cruise.

## **Sound in the Oceans**

Satellite Eye collects for the [Sound in the Oceans Project](#) satellite images focused on areas where the large whales are living. One area is near the Azores Islands where we will check high-resolution optical images for the presence of whales. In addition the ocean chlorophyll content and sea surface temperature images may help understand the travelling of whales and dolphins observed from the ship also in the Indian Ocean, near the Solomon Islands and along the Antarctic.

## **Plankton Dynamics**

Satellite Eye collects for the [Plankton Dynamics Project](#) satellite images of ocean surface temperature, ocean colour, chlorophyll content and wind conditions. The satellite images provide overviews useful both for the cruise planning as well as the physical and biological functioning of the plankton communities that will be investigated on-board Galathea. Near Broome the wave dynamics and phytoplankton will be investigated in detail from the ship and from satellite.

## **Eels Breeding**

Satellite Eye collects for the project [Eels Breeding in the Sargosso Sea](#) satellite images on areas where the eels are breeding. Large gradients in sea surface temperature can be

seen from the satellites as well as sea surface currents. It is interesting to compare the breeding sites of the European eel observed from the ship to the satellite images overview of the state of the physics of the ocean.

### **Cool-water carbonate**

Satellite Eye collects for the project [Cool-water Carbonate Mounds near Australia](#) satellite images of ocean sea surface temperature, chlorophyll content and ocean wind conditions. The planning of water sampling with CTD and ADCP will be partly based on near-real-time sea surface temperature maps from satellite. The major goal of the project is to understand the cool-water carbonate sedimentation processes.

### **Icefish of Antarctica**

Satellite Eye collects for the [Icefishes of Antarctica](#) satellite images of the sea ice near Antarctica focused on the Ross Sea where it is planned to catch icefishes if the sea ice conditions permits it. Furthermore the ice conditions near Terra Nova Base will be mapped to clarify the possibility of entering land for the project

### **Galapagos plants**

Satellite Eye collects for the project '[Comparative research on plant populations and plant communities in the Galapagos Islands and Isla de la Plata](#)' satellite images of the different islands on which a field work will be conducted in February and March 2007. The images are high-resolution images, that can be used to characterize different plant zones and the development through time

### **Tranquebar**

Satellite Eye collects for the project [The Fishermen Community in Tranquebar: Anthropological investigations of socio-economic living conditions 1980-2010](#) satellite images of the area. The population typically lives very close to the ocean. Large parts of their urban quarters disappeared during the tsunami and 6-800 people lost their lives. The project consists of life-stories told in year 1981 and again in year 2006 on their views on changes in society, tsunami, coastal changes, cyclones, etc. The satellite images documents the changes of the coastline and coastal areas during time.

## 6.2 Coordinators and contacts

*Table. Project cooperation.*

#	Project	PI-institute	PI	Contact	Institute
1	Carboncycle	AU	Kathrine Richardson	Lise Lotte Sørensen	Risø
2	Gravity	DRC	Rene Forsberg	Ole Balthazar Andersen	DRC
3	St.Croix	SDU	Janne J. Liburd	Niels Chr. Nielsen	SDU
4	Mercury	DMU	Henrik Skov	Henrik Skov	DMU
5	Winmargin	GEUS	Antoon Kuijpers	Jepser Bartholdy	GEUS
6	Greenland	GEUS	Naja Mikkelsen	Ole Bennike	GEUS
7	Bellona	GI-KU	Ole Mertz	Rasmus Fensholt	GI-KU
8	Salomon birds	Zool. Mu.	Jon Fjeldså	Knud Jönsson	Zool. Mu.
9	Sea turtles	DMU	Rune Dietz	Rune Dietz	DMU
10	Oxygen	SDU	Bo Thamdrup	Tage Dalsgaard	DMU
11	DOM	DMU	Stiig Markager	Stiig Markager	DMU
12	Sound in ocean	DMU	Jakob Tougaard	Jakob Tougaard	DMU
13	Plankton	DMU	Torkel Gissel	Torkel Gissel Nielsen	DMU
14	Eel breeding	DFU	Michael Møller Hansen	Peter Munk	DFU
15	Carbonwater	Geol. UK	Mads Huuse	Lars Chresten Lund-Hansen	AU
16	Ice fish	Zool. Mu.	Peter Rask Møller	John Fleng Steffensen	BI-KU
17	Galapagos plants	Bot.Have	Ole Jørgen Hamann	Henning Adersen	BI-KU
18	Tranquebar	CKK-KU	Esther Fihl	Esther Fihl	CKK-KU

## 7 Publication

Satellite Eye for Galathea 3 has aimed to make the project publicly known and to reach to the science projects onboard Galathea, the pupils and teachers in the classrooms in Denmark and the general public. It means we have written most both in Danish and English.

Publication has been through oral and poster presentations, distribution of information flyers, oral presentation to Danish teachers in professional journals and at teachers meetings, education to school classes including pupils and teachers, press release, web-logs, and abstracts submitted to conferences.

### 7.1 Weekly image and links

The weekly image is published with a short scientific and technical description every week to highlight various themes and locations

[http://www.satelliteeye.dk/weeklyimages\\_uk.htm](http://www.satelliteeye.dk/weeklyimages_uk.htm)

Links to Satellite Eye are found at many web-sites. This includes a link at the front page of the Danish Expedition Foundation <http://www.galathea3.dk/dk> and a link at the front page of the EMU <http://galathea3.emu.dk/>

### 7.2 Press listing

An updated listing of news as press release, newspapers, non-science journals and web-logs are listed at [http://www.satelliteeye.dk/news\\_uk.htm](http://www.satelliteeye.dk/news_uk.htm)

20.01.2007, Jyllands-Posten

[Danske iskort hjælper skibe ved Antarktis](#)

20.01.2007, EMU Galathea 3

[I kolde farvande - Antarktis,](#)

15.01.2007, Risø Galathea web-log

[Vindkort med Vædderen](#)

10.01.2007, Risø Galathea web-log

[Vind omkring New Zealand](#)

10.01.2007, DTU Avisen

[Med falkeblink på verdensomsejlingen \(Side 8 og 9\)](#)

03.01.2007, Risø Galathea web-log

[Beskrivelse af vejret over Sydhavet](#)

28.12.2006, Jyllands-Posten

[Kronik: Anders Lund Madsen eller Galathea?](#)

14.12.2006, RisøNyt

[Vinden førte hende til Risø](#)

08.12.2006, NBI Avisen  
[Satellite Eye tager temperaturen på havet](#)

06.12.2006, EMU Danmarks Undervisningsportal  
[Satellite Eye Vindkraft Kap Verde](#)

28.11.2006, EMU Gymnasiale uddannelser  
[Space Camp konkurrencen](#)

26.11.2006, Sarepta  
[Galathea 3 expedition and Satellite Eye](#)

18.11.2006, Web-log fra Galathea 3 ved post.doc. Karen Marie Hilligsøe  
[Varmt vand](#)

07.11.2006, Risø Galathea weblog  
[Rekord høj CO2 afgang fra hav](#)

06.11.2006, GLOBE program  
[A GLOBE-Denmark and GLOBE-Greenland project](#)

01.11.2006, Galathea Ekspeditionen undervisning  
[Galathea Ekspeditionen](#)

27.10.2006, ESA  
[Galathea udnytter friske satellitbilleder](#)

26.10.2006, Politiken  
[Vædderen i stærk strøm](#)

17.10.2006, DMI  
[Vædderen i hvirvlernes vold](#)

15.10.2006, Mikro Værkstedet  
[Fysik til søs](#)  
[Se videoklip om Bølger](#)

15.10.2006, DanfossUniverse  
[Bølger](#)

12.10.2006, EMU web-log, lærer Peter Bondo Christensen ombord fra Vædderen  
[Et øje i det høje](#)

12.10.2006, Jyllands-Posten web-log, undervisningsminister Bertel Haarder ombord fra Vædderen  
[Høj sol, høj sø og albatrosser](#)

11.10.2006, Politiken internet  
[Satellitbilleder skaber overblik](#)

06.09.2006, Dansk Ekspeditionsfond  
[Dagbogsblade fra Galathea 3](#)

01.09.2006, Politiken  
[Hvor er Vædderen? Følg Vædderen med Google Earth](#)

30.08.2006, CECE  
[Galathea expedition](#)

27.08.2006, SolData Instruments  
[Galathea 3 data](#)

25.08.2006, Risø  
[Satellitbilleder viser Galathea-forskerne vej](#)

16.08.2006, TV2  
[Følg vejret omkring Vædderen](#)

14.08.2006, Softpedia  
[Danish Expedition Around the World Tracked by Envisat Satellite](#)

14.08.2006, ESA  
[Rumfart i 15 Galathea-projekter](#)

11.08.2006, Folkeskolen.dk  
[En verdensomsejling med skoleperspektiv](#)

11.08.2006, ESA  
[Danish expedition ship tracked by Envisat satellite](#)

11.08.2006, DMI  
[Galathea 3 stævner ud](#)

31.07.2006, Teknikogviden.dk  
[Miljøsatellit supplerer kikkert og kompas](#)

31.07.2006, Geografforbundet  
[Geografisk Orientering, Nr 4, Juli 2006. Artikel: Satellite Eye for Galathea 3 af Peter Brøgger Sørensen, side 552-557 Tilgængelig fra Geografforbundet](#)

18.07.2006, ESA  
[Skildpadder, gletsjere og havenes kulstof](#)

12.07.2006, ESA  
[Satellit følger forskningsskib](#)

14.06.2006, UVM Presse  
[Jorden rundt med Galathea 3](#)

03.06.2006, Syddansk Universitet  
[Galathea 3 Kick off seminar](#)

22.03.2006, DMI  
[DMI leverer satellitbilleder til Galathea 3](#)

21.03.2006, Ingeniøren  
[Interaktivt atlas over Galathea-ruten](#)

21.03.2006, Risø  
[Satellitter skaber levende atlas i Galathea 3's kølvand](#)

## 7.3 International publication

### **Envisat symposium, Montreux, Switzerland, April 2007**

Two accepted oral presentations at ENVISAT Symposium, Montreux, 23-27 April 2007  
Conference programme available at <http://www.envisat07.org/>

Conference proceedings papers will be written.

Title: The Marine Carbon Cycle from North to South along the Galathea 3 Route

Authors: Christiansen, Merete Bruun; Soerensen, Lise Lotte; Nissen, Jesper; Hasager, Charlotte Bay,

Affiliations: Risø National Laboratory -DTU, DENMARK

Title: Envisat for School: The Satellite Eye for the Galathea 3 Expedition

Authors: Hasager, Charlotte Bay<sup>1</sup>; Sørensen, Peter Brøgger<sup>2</sup>; Pedersen, Leif Toudal<sup>3</sup>; Høyer, Jacob L.<sup>4</sup>; Viskum Jørgensen, Peter<sup>4</sup>; Højerslev, Niels Kristian<sup>5</sup>; Lichtenegger, Jürg<sup>6</sup>

Affiliations: <sup>1</sup>Risø National Laboratory -DTU, DENMARK; <sup>2</sup>ESA-consultant for EDUSPACE, DENMARK; <sup>3</sup>Danish Center for Remote Sensing, Technical University of Denmark, DENMARK; <sup>4</sup>Danish Meteorological Institute, DENMARK; <sup>5</sup>Niels Bohr Institute, University of Copenhagen, DENMARK; <sup>6</sup>ESA-consultant for EDUSPACE, SWITZERLAND

### **IGARSS 2007, Barcelona, Spain, July 2007**

IGARSS 2007 International Geoscience and Remote Sensing Symposium Conference programme available at

<http://www.grss-ieee.org/menu.taf?menu=conferences&detail=IGARSS>, Barcelona, 23-27 July 2007

Session: Education and Policy: Remote Sensing and the Internet

Title: Satellite Eye for the Galathea 3 ship expedition: global tour 2006-2007

Authors: Charlotte Bay Hasager, Ole Balthazar Andersen, Merete Bruun Christiansen, Niels Kristian Højerslev, Jacob L. Høyer, Peter Viskum Jørgensen, Jürg Lichtenegger, Leif Toudal Pedersen, Michael Schultz Rasmussen, Peter Brøgger Sørensen.

Affiliations: <sup>1</sup>Risø National Laboratory -DTU, DENMARK; <sup>2</sup>ESA-consultant for EDUSPACE, DENMARK; <sup>3</sup>Danish Center for Remote Sensing, Technical University of Denmark, DENMARK; <sup>4</sup>Danish Meteorological Institute, DENMARK; <sup>5</sup>Niels Bohr Institute, University of Copenhagen, DENMARK; <sup>6</sup>ESA-consultant for EDUSPACE, SWITZERLAND

Abstract is submitted and it is in evaluation (answer on acceptance late March 2007)

## **EGU 2007, Vienna, Austria, April 2007**

EGU 2007 European Geosciences Union General Assembly, 16-20 April 2007, Vienna  
<http://meetings.copernicus.org/egu2007/>

Two presentations are accepted as oral.

Session: Integrating Activities in Environmental Science Education - Approaches and Perspectives

Title: The world expedition Galathea 3 seen from Satellite Eye

Authors: Charlotte Bay Hasager, Ole Balthazar Andersen, Merete Bruun Christiansen, Niels Kristian Højerslev, Jacob L. Høyer, Peter Viskum Jørgensen, Jürg Lichtenegger, Leif Toudal Pedersen, Michael Schultz Rasmussen, Peter Brøgger Sørensen.

Abstract online: <http://www.cosis.net/abstracts/EGU2007/01610/EGU2007-J-01610.pdf>

Session: Air-sea interactions

Title: The Galathea 3 expedition combining results from satellite and ship

Authors: C. B. Hasager, M. B. Christiansen, L. L. Soerensen

Abstract online: <http://www.cosis.net/abstracts/EGU2007/01608/EGU2007-J-01608.pdf>

## **Eighth Informal Conference on Atmospheric and Molecular Science**

The Eighth Informal Conference on Atmospheric and Molecular Science June 8 to 10, 2007 LO-Skolen Conference Center, Helsingør, Denmark Sponsored by CCAR, The Copenhagen Center for Atmospheric Research

For more information please visit the conference website:  
<http://kl5alfa.ki.ku.dk/noneck/index.html>

Invited speaker:

Niels Højerslev, University of Copenhagen, Galathea Expedition

Affiliation: NBI-KU



## 8 Statistics

### 8.1 Statistics on satellite images

Envisat MERIS and ASAR; SPOT; PROBA

(Status 22.2.07)

Preparation phase (delivered starting April, selected from archive)

original data: 33 MERIS 1 AATSR 10 ASAR (44)

derived tif data: 25 MERIS, 4 ASAR, 4 ASAR-multitemp. 2 Landsat

Envisat data ordered for near real time delivery, starting 11 August

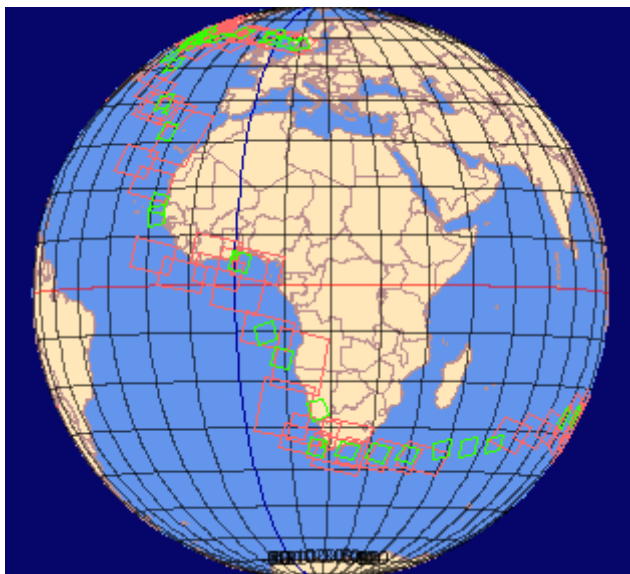
A total amount of 279 scenes were asked to be acquired:

128 MERIS FR , 128 ASAR-WS, 8 ASAR-IM, 16 ASAR-APP

PROBA images from 13 places, totally 71 images (all acquired for the project)

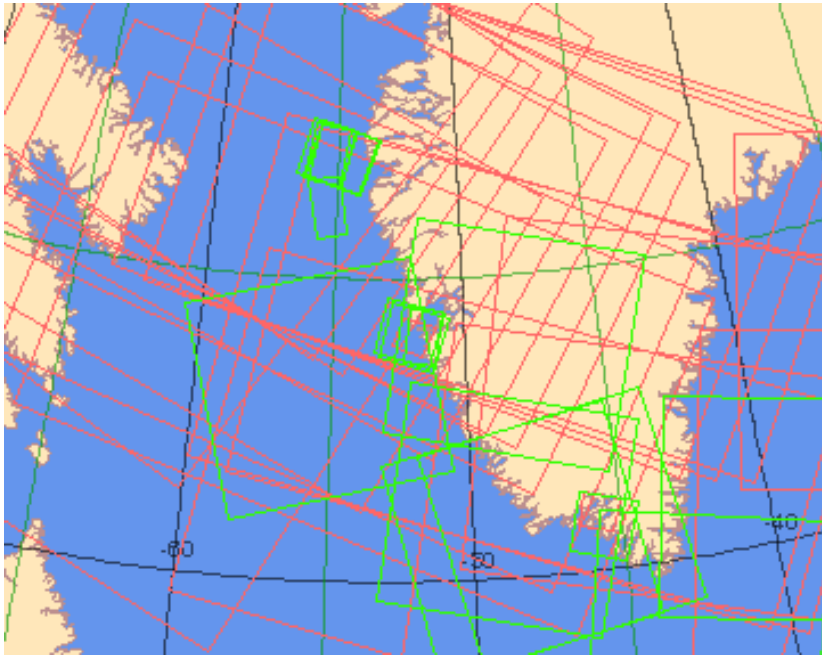
SPOT-Pan and XS from 14 places totally 41 images (2 images acquired from the project  
all the others were selected from the archive)

Overview of requested Envisat images for near real time data delivery:



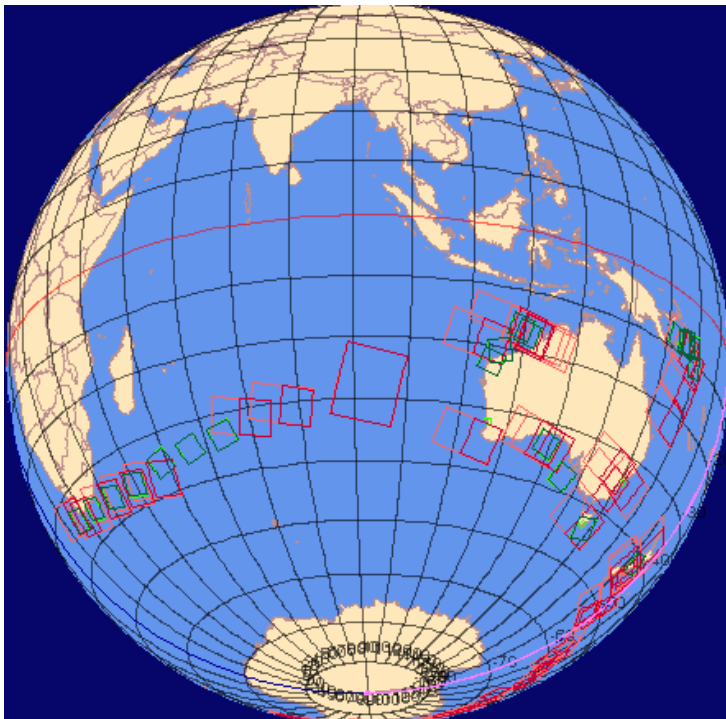
*Envisat data coverage from Copenhagen to the Indian Ocean*

*Green: ASAR - Red: MERIS FR*



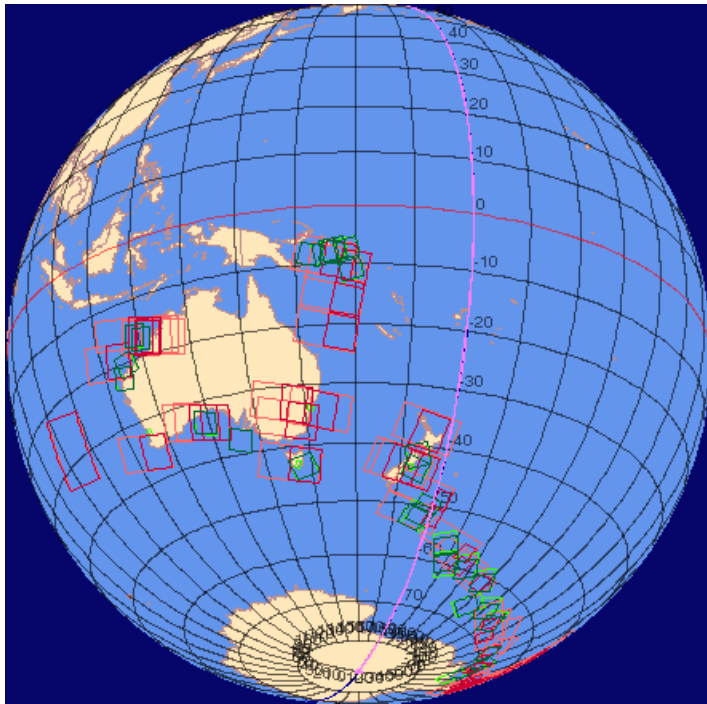
*Detail coverage over Greenland*

*Green: ASAR - Red: MERIS FR*



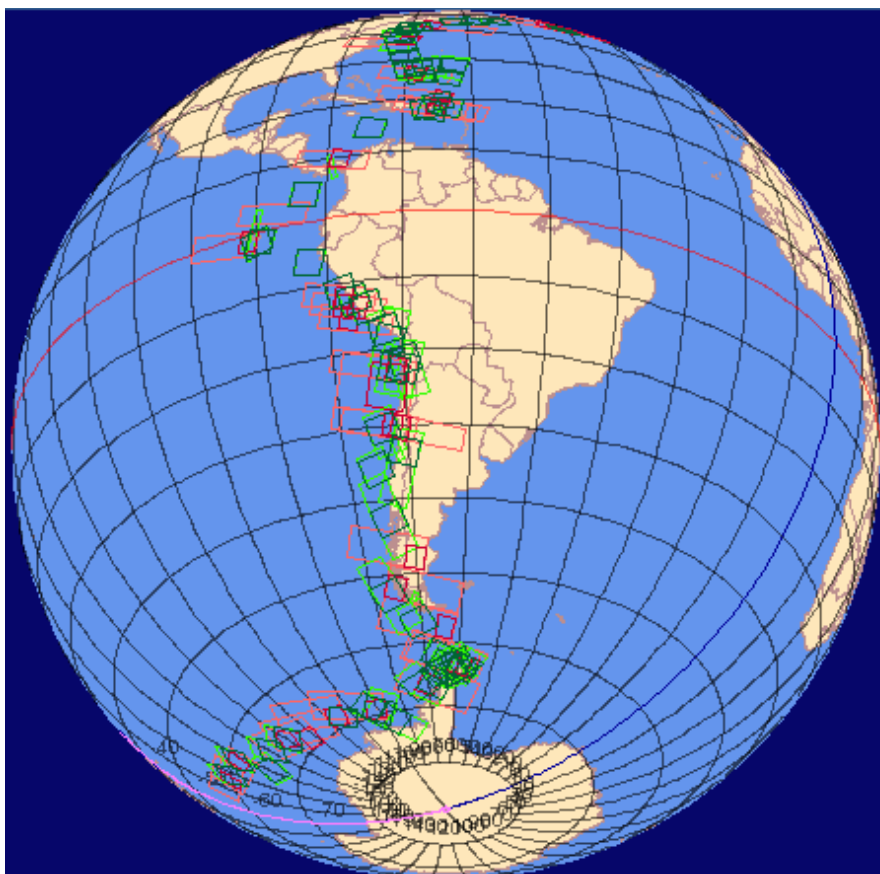
*Envisat data coverage Indian Ocean and Australia*

*Green: ASAR - Red: MERIS FR*



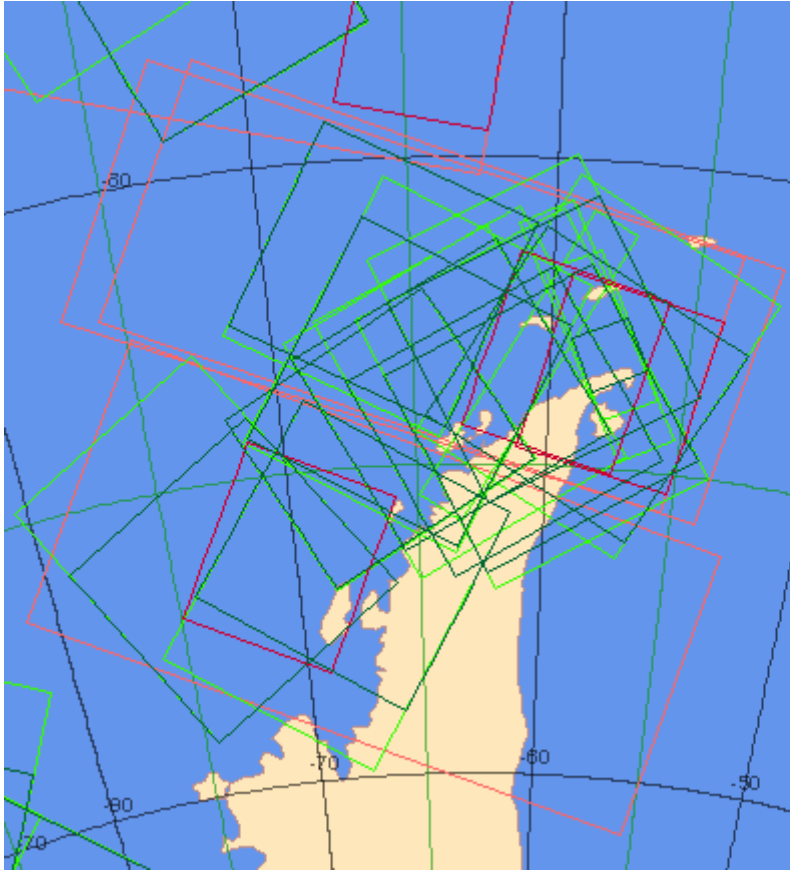
*Envisat Coverage Australia-Antarctica*

*Green: ASAR - Red: MERIS FR*



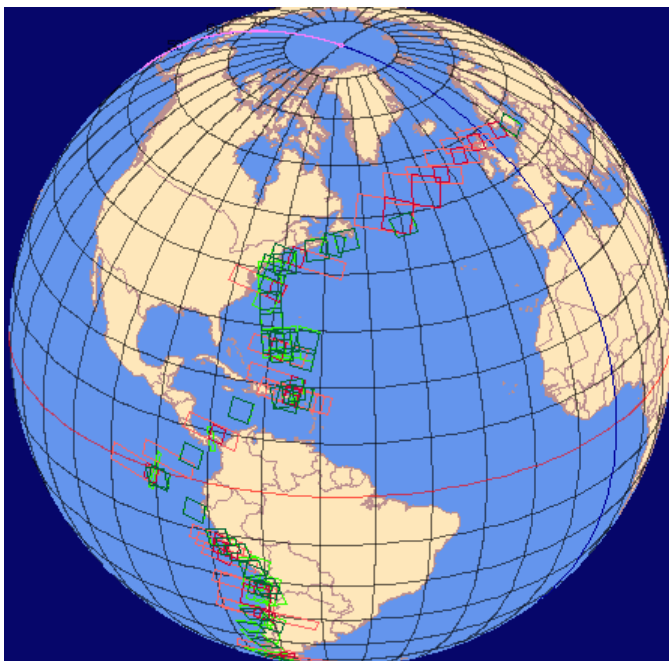
*Envisat data coverage Antarctica-South America*

*Green: ASAR - Red: MERIS FR*



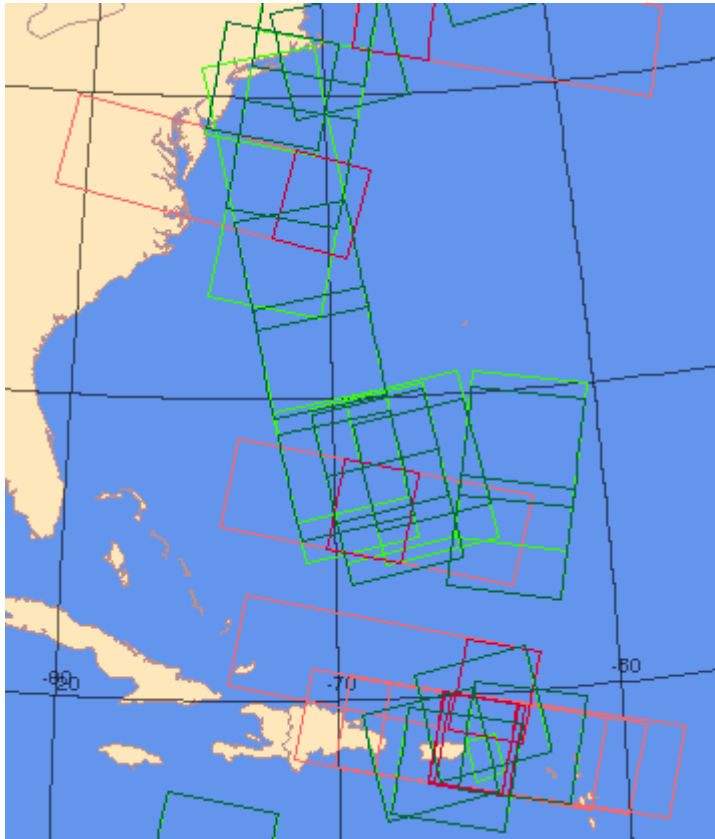
*Envisat data coverage Antarctic Peninsula*

*Green: ASAR - Red: MERIS FR*



*Envisat data coverage North America and Atlantic*

*Green: ASAR - Red: MERIS FR*



*Im Envisat data coverage St.Thomas-Boston*

*Green: ASAR - Red: MERIS FR*

High resolution images purchased

Nine QuickBird images have been purchased each covering ca 25 km<sup>2</sup>:

Solomon Birds: 4

Belona Island, Solomon Islands, the Clip project: 2

Thorshavn: 1

Nuuk: 1

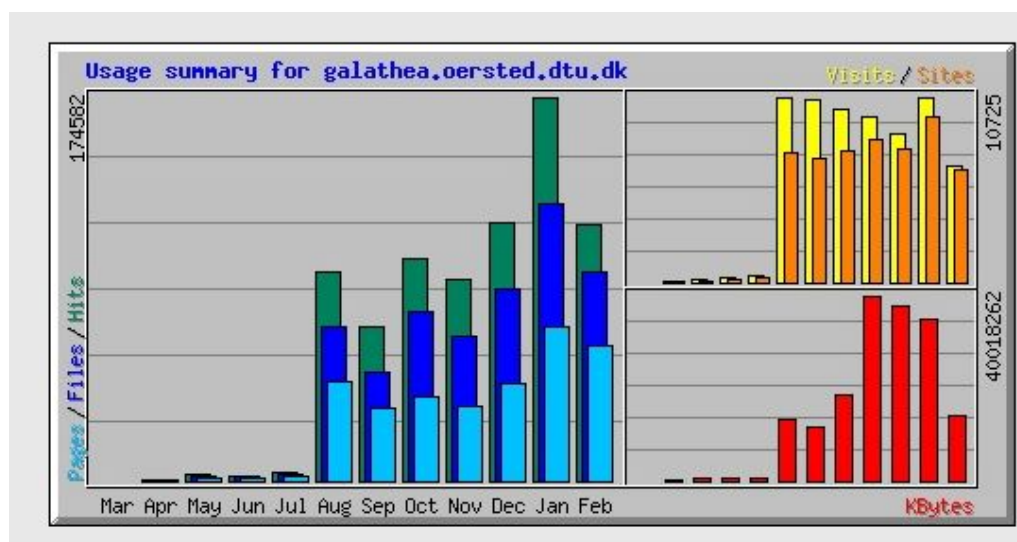
Copenhagen: 1

Medium and low-resolution images continuous download

Images from medium and low-resolution encompass geostationary e.g. Meteosat, GOES, etc.; polar orbiters, e.g. NOAA AVHRR, Landsat, Topex-Poseidon, Jason, among several others.

## 8.2 Statistics of web-visitors at <http://galathea.oersted.dtu.dk>

At <http://galathea.oersted.dtu.dk> all images and in-situ observations in the Satellite Eye project are archived and made publicly available. Statistics on the use is presented below.

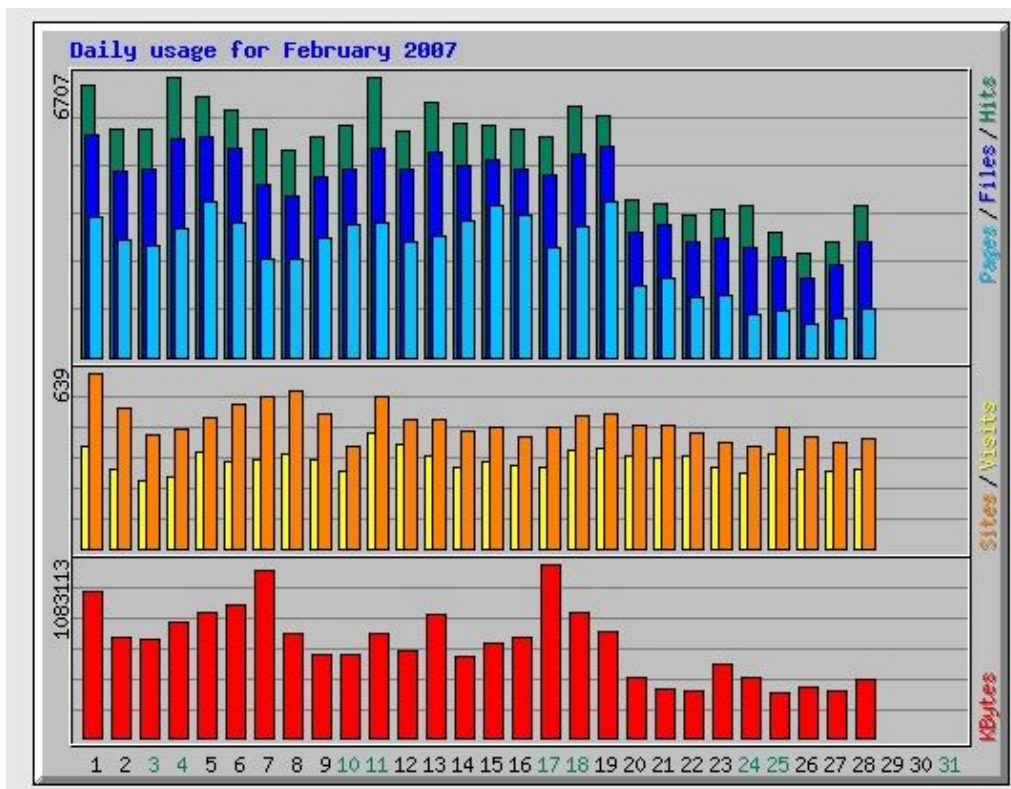


Sum per month from April 2006 to 21 February 2007. See the color identification below.

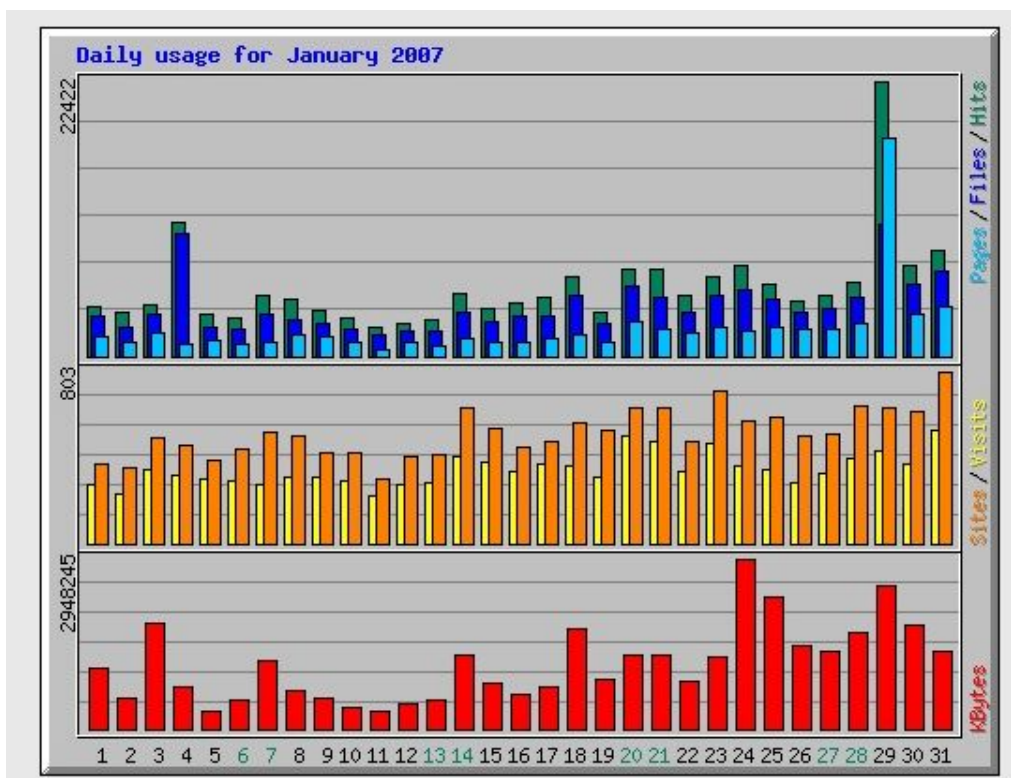
Summary by Month										
Month	Daily Avg				Monthly Totals					
	Hits	Files	Pages	Visits	Sites	KBytes	Visits	Pages	Files	Hits
Feb 2007	5530	4513	2936	321	6470	14064141	6747	61668	94776	116138
Jan 2007	5631	4069	2270	343	9603	34833482	10661	70371	126159	174582
Dec 2006	3788	2818	1433	277	7702	37839618	8615	44430	87366	117449
Nov 2006	3041	2196	1119	319	8252	40018262	9572	33588	65892	91239
Oct 2006	3249	2473	1236	323	7594	18760283	10038	38340	76693	100738
Sep 2006	2331	1643	1115	351	7172	11681373	10535	33454	49302	69938
Aug 2006	3056	2268	1467	345	7481	13420646	10725	45487	70313	94744
Jul 2006	133	95	66	12	298	723438	387	2055	2969	4144
Jun 2006	81	62	34	8	180	543650	247	1032	1875	2447
May 2006	89	68	28	4	94	768574	136	872	2119	2773
Apr 2006	87	80	8	1	4	138881	11	77	728	791
Totals						172792347	67674	331374	578192	774983

Sum per month from April 2006 to 21 February 2007.

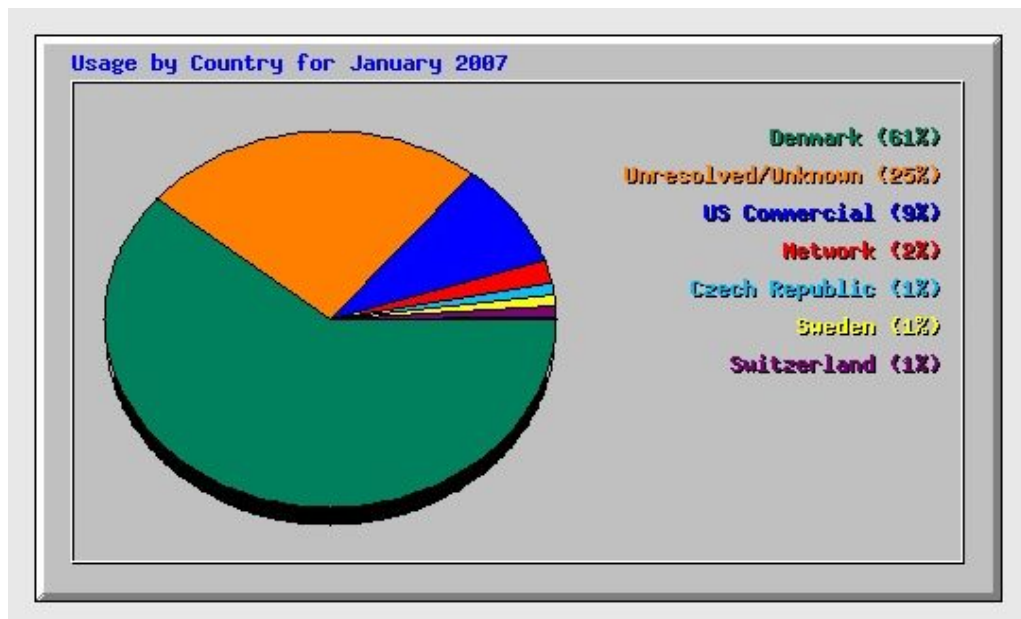




Statistics per day for February 2007. See the color identification above.



Statistics per day for January 2007. See the color identification above.



*Statistics on visitors by country for January 2007*



Top 40 of 63 Total Countries							
#	Hits		Files		KBytes		Country
1	106284	60.88%	76121	60.34%	11166562	32.06%	Denmark
2	42980	24.62%	34066	27.00%	6782186	19.47%	Unresolved/Unknown
3	15884	9.10%	10564	8.37%	14055486	40.35%	US Commercial
4	2831	1.62%	1459	1.16%	252909	0.73%	Network
5	1147	0.66%	1051	0.83%	1690321	4.85%	Czech Republic
6	1094	0.63%	731	0.58%	142978	0.41%	Sweden
7	995	0.57%	605	0.48%	333589	0.96%	Switzerland
8	524	0.30%	455	0.36%	32719	0.09%	Australia
9	429	0.25%	262	0.21%	31433	0.09%	Greenland
10	317	0.18%	246	0.19%	27286	0.08%	Mexico
11	284	0.16%	185	0.15%	52835	0.15%	Norway
12	270	0.15%	214	0.17%	33100	0.10%	Germany
13	266	0.15%	230	0.18%	39000	0.11%	Italy
14	191	0.11%	136	0.11%	21643	0.06%	Iceland
15	156	0.09%	125	0.10%	10772	0.03%	Brazil
16	96	0.05%	86	0.07%	3286	0.01%	Canada
17	80	0.05%	64	0.05%	7164	0.02%	New Zealand (Aotearoa)
18	73	0.04%	54	0.04%	15425	0.04%	France
19	66	0.04%	52	0.04%	10334	0.03%	Faroe Islands
20	56	0.03%	48	0.04%	18327	0.05%	Poland
21	51	0.03%	33	0.03%	3808	0.01%	Japan
22	43	0.02%	32	0.03%	15046	0.04%	Netherlands
23	36	0.02%	32	0.03%	10647	0.03%	Hungary
24	34	0.02%	25	0.02%	7925	0.02%	Finland
25	32	0.02%	25	0.02%	2214	0.01%	Portugal
26	29	0.02%	20	0.02%	392	0.00%	US Educational
27	29	0.02%	24	0.02%	2828	0.01%	Non-Profit Organization
28	28	0.02%	20	0.02%	17274	0.05%	United Kingdom
29	24	0.01%	6	0.00%	62	0.00%	Bosnia and Herzegovina
30	23	0.01%	20	0.02%	3785	0.01%	Romania
31	20	0.01%	16	0.01%	7683	0.02%	Malaysia

*Statistics on visitors by country for January 2007*

Top 55 of 6528 Total URLs					
#	Hits	kBytes		URL	
1	84385	48.34%	18056431	51.84%	GE/google
2	10743	6.15%	184543	0.53%	/GE.html
3	2582	1.48%	105947	0.30%	/images/latest_sst_satl.png
4	2311	1.32%	72829	0.21%	/images/latest_sst_seqatl.png
5	1878	1.08%	14936	0.04%	/
6	1800	1.03%	68339	0.20%	/images/latest_sst_sin.png
7	1689	0.97%	101355	0.29%	/images/latest_sst_seqin.png
8	1439	0.82%	12152	0.03%	/SatEyeGE.jpg
9	1438	0.82%	7097	0.02%	/JAVA.jpg
10	1426	0.82%	7596	0.02%	/verdenskort_small.jpg
11	1357	0.78%	46158	0.13%	/images/latest_sst_neqatl.png
12	1228	0.70%	68252	0.20%	/images/latest_sst_natlant.png
13	853	0.49%	39473	0.11%	/images/latest_swh.png
14	744	0.43%	15956	0.05%	/GE_forklaring.html
15	559	0.32%	3420	0.01%	/base/areas/
16	461	0.26%	9079	0.03%	/images/latest_sst_spac.png
17	404	0.23%	44982	0.13%	/Brugsanvisning_20060906.pdf
18	389	0.22%	602	0.00%	/default.layers
19	387	0.22%	707362	2.03%	/bathym_med.jpg
20	377	0.22%	20951	0.06%	/images/latest_Qscat_Wind.png
21	297	0.17%	8734	0.03%	/GE_data.html
22	294	0.17%	4770	0.01%	/GE_e.html
23	276	0.16%	4806	0.01%	/GE_animation.html
24	271	0.16%	2026	0.01%	/Landkort1.html
25	246	0.14%	52198	0.15%	/verdenskort1.gif
26	212	0.12%	106232	0.30%	/images/latest.rssst-fix.png
27	207	0.12%	87	0.00%	/index1.html
28	187	0.11%	12956	0.04%	/images/latest_ssh.png

*Statistics of visitors on URLs for January 2007*

Top 40 of 277 Total Entry Pages					
#	Hits		Visits		URL
1	10743	6.15%	8315	77.27%	<a href="#">/GE.html</a>
2	1878	1.08%	752	6.99%	<a href="#">/</a>
3	294	0.17%	192	1.78%	<a href="#">/GE_e.html</a>
4	744	0.43%	153	1.42%	<a href="#">/GE_forklaring.html</a>
5	559	0.32%	131	1.22%	<a href="#">/base/areas/</a>
6	387	0.22%	109	1.01%	<a href="#">/bathym.med.jpg</a>
7	271	0.16%	71	0.66%	<a href="#">/Landkort1.html</a>
8	297	0.17%	62	0.58%	<a href="#">/GE_data.html</a>
9	207	0.12%	62	0.58%	<a href="#">/index1.html</a>
10	127	0.07%	56	0.52%	<a href="#">/index_e.html</a>
11	67	0.04%	51	0.47%	<a href="#">/GE_forklaring_e.html</a>
12	1439	0.82%	44	0.41%	<a href="#">/SatEyeGE.jpg</a>
13	1438	0.82%	32	0.30%	<a href="#">/JAVA.jpg</a>
14	52	0.03%	32	0.30%	<a href="#">/images/20070113.envisat.s.GMM.1km3daymosaic.jpg</a>
15	122	0.07%	21	0.20%	<a href="#">/base/areas/verdenskort1.gif</a>
16	276	0.16%	19	0.18%	<a href="#">/GE_animation.html</a>
17	168	0.10%	17	0.16%	<a href="#">/havne.html</a>
18	39	0.02%	14	0.13%	<a href="#">/base/areas/Africa/</a>
19	29	0.02%	13	0.12%	<a href="#">/base/areas/Australia/</a>
20	24	0.01%	12	0.11%	<a href="#">/base/areas/Europe/</a>
21	25	0.01%	10	0.09%	<a href="#">/GE_animation_e.html</a>
22	25	0.01%	10	0.09%	<a href="#">/base/areas/Azores/</a>
23	14	0.01%	10	0.09%	<a href="#">/base/areas/ChristchurchNZ/</a>
24	30	0.02%	10	0.09%	<a href="#">/base/areas/Perth/</a>
25	57	0.03%	9	0.08%	<a href="#">/base/areas/Antofagasta/</a>
26	15	0.01%	9	0.08%	<a href="#">/base/areas/Ghizo/</a>
27	32	0.02%	9	0.08%	<a href="#">/base/areas/Salomon/</a>
28	24	0.01%	9	0.08%	<a href="#">/base/areas/Thorshavn/</a>
29	13	0.01%	8	0.07%	<a href="#">/Landkort1_e.html</a>
30	23	0.01%	8	0.07%	<a href="#">/base/areas/Broome/</a>
31	39	0.02%	8	0.07%	<a href="#">/base/areas/Nuuk/</a>

*Statistics on entry pages for January 2007*

Top 10 of 400 Total Exit Pages					
#	Hits		Visits		URL
1	10743	6.15%	7351	71.33%	<a href="#">/GE.html</a>
2	1426	0.82%	497	4.82%	<a href="#">/verdenskort_small.jpg</a>
3	744	0.43%	347	3.37%	<a href="#">/GE_forklaring.html</a>
4	387	0.22%	218	2.12%	<a href="#">/bathym.med.jpg</a>
5	294	0.17%	174	1.69%	<a href="#">/GE_e.html</a>
6	1878	1.08%	153	1.48%	<a href="#">/</a>
7	297	0.17%	147	1.43%	<a href="#">/GE_data.html</a>
8	276	0.16%	127	1.23%	<a href="#">/GE_animation.html</a>
9	1438	0.82%	88	0.85%	<a href="#">/JAVA.jpg</a>
10	127	0.07%	69	0.67%	<a href="#">/index_e.html</a>

*Statistics on exit pages for January 2007*



### 8.3 Statistics of EMU

A user survey published 27 February 2007 from EMU at

<http://galathea3.emu.dk/brugerundersogelse.html>

shows that many use the Galathea3 educational material.

#### **Copy from the evaluation:** (In Danish)

##### Midtvejsevaluering

610 personer har svaret på brugerundersøgelsen "Galathea3 - Hjælp os med at gøre hjemmesiden bedre". Sammenholdes disse svar med trafiktallene på hjemmesiden, bliver resultaterne at:

Hjemmesiden galathea3.emu.dk er brugt i undervisningen på alle niveauer fra børnehaveklasse til gymnasier og i læreruddannelsen med 16-19.000 unikke brugere pr. måned svarende til ca. 5.000 brugere / uge.

De fleste brugere er fra grundskolen med vægt på 3.-7.klasse.

I indskoling, på mellemtrinet og de ældste klasser i grundskolen bruges hjemmesiden både i natur/teknik, dansk, historie, biologi, geografi og andre fag samt ikke mindst i tværfaglige sammenhænge. Siderne bruges altså ikke kun i naturfagene, men bredt over fagrækken.

Nogle klasser følger Galathea løbende over hele året, mens andre arbejder med udvalgte emner i kortere eller længere perioder.

Gymnasiet har færre brugere end grundskolen. På dette niveau kan der arbejdes mere specialiseret i relation til udvalgte forskningsprojekter. Omfanget af arbejdet og timeforbruget kan her være ganske stort og forløbe over hele året. Typisk arbejder gymnasieklasserne i naturfagene med selvformulerede projekter i relation til den forskning, der foregår på skibet.

MiniGalathea er blevet en stor succes, hvor mange elever ikke bare arbejder med emnerne i skolen, men også hjemmefra følger EMUs færd jorden rundt via nogle faglige tekster og inspirerende fotos fra ekspeditionen. Blandingen af fakta og fiktion for de yngste elever har vist sig at være kimen til en begyndende interesse for det naturvidenskabelige felt.

Det tilkendegives, at hovedparten af lærerne og eleverne vil bruge webstedet fremover. 43 % vil helt sikkert fortsætte med at bruge det, 45 % vil nok bruge det, mens 5 % ikke forventer at ville bruge det. 63 % af respondenterne er lærere, og heraf er 67 % ansat i grundskolen.

#### **Brugen af hjemmesiden**

Brugen af hjemmesiden skal ses i lyset af naturfagernes placering og omfang i både grundskolen og gymnasierne. Resultatet må betegnes som udmærket, idet hjemmesiden bliver brugt af rigtig mange elever, lærere, skoler og uddannelsesinstitutioner. Jo højere op i uddannelsesniveaue jo mere specialiseret og fagrettet er anvendelsen af webstedet.

Lærerne har trods planlagte årsplaner formået at inddrage projektet som en aktuel begivenhed, fagligt emne eller som tema for årgange eller hele skoler.

Øget interesse for naturvidenskab vil på længere sigt vise sig, når dagens yngste elever i grundskolen senere skal vælge studieretning i gymnasiet og uddannelse i fremtiden.

#### **8.4 Statistics of Dansk Ekspeditionsfond**

Evaluation by Dansk Ekspeditionsfond shows a good impact of Galathea 3 in general both for science and education.

Statistics on science results

<http://www.galathea3.dk/dk/Menu/Nyheder/Nyt+om+Galathea+3/Status%2c+forskning>

Statistics on impact in schools and media

<http://www.galathea3.dk/dk/Menu/Nyheder/Nyt+om+Galathea+3/Status%2c+formidling>

Satellite Eye is mentioned in the education text as one of the sites of importance.

## 9 Conclusion and perspective

In summary, the aims of Satellite Eye are fulfilled as concerns the planned work for the first year. The cooperation with many science projects and school classes onboard Galathea is actively on-going. The web-site [www.satelliteeye.dk](http://www.satelliteeye.dk) hosts the 'weekly image' and general project information, including a listing of publication.

The satellite image database at <http://galathea.oersted.dtu.dk> is frequently visited and much material is downloaded every day. This is relevant both for the researchers onboard for their planning and in the educational projects in the classrooms. Many images from Envisat MERIS and ASAR, SPOT and PROBA are obtained through Eduspace, the educational platform of ESA, the European Space Agency.

Satellite Eye has produced a series of 'running projects' and some 'case studies' for education. The 'running projects' are relevant along the entire cruise track whereas the 'case studies' are mainly relevant in geographically limited regions. All educational projects and cases rely on satellite images, *in-situ* observations and other information, e.g. from the Galathea 3 research projects.

Perspectives for Satellite Eye are to continue the work on collecting satellite images in year 2007 to the end of the Galathea 3 expedition in late April 2007.

The educational material from all 'running projects' and 'case studies' will be ready for the school year 2007/2008 on the EMU web, and the satellite images and *in-situ* observations from the ship will be available from <http://galathea.oersted.dtu.dk>

An educational film and a television program are being worked on in the Satellite Eye project in cooperation with STV. This work is started as a new project: Multimedia for VirtuelGalathea3 e-learning. This is supported by Tips and Lottopuljen at UVM. It is the aim of Satellite Eye to contribute to VirtuelGalathea3 e-learning to provide a state-of-the-art educational platform for the pupils and teachers in the Danish schools in the future years.

Risø's research is aimed at solving concrete problems in the society.

Research targets are set through continuous dialogue with business, the political system and researchers.

The effects of our research are sustainable energy supply and new technology for the health sector.

